Biomarker analysis of the Ediacaran macrofossil *Beltanelliformis*

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The Ediacara biota (580-540 Ma) marks the first global appearance of complex macroscopic organisms in the palaeontological record and preludes the appearance of the animal-dominated world of the Phanerozoic. Although it is clear that the Ediacara biota reflects one of the most important milestones in the evolution of life, their origin remains enigmatic. The controversies about the phylogenetic status of the Ediacaran organisms have raged for several decades, and new advances are needed to provide a breakthrough.

The White Sea region in Russia offers not only diverse and fine-preserved impressions of the Ediacara biota, it is also the only place where they occur together with well-preserved biomarkers. Biomarkers may provide new answers about the origin and environments of the Ediacara biota. Here we report the results of the first biomarker analyses of organically preserved Ediacaran macrofossils.

Beltanelliformis are one of the most revisited Ediacaran macrofossils. They have been interpreted as abiological structures, jellyfish bodies, sedentary polyps, planktonic algae, fungal colonies, colonial cyanobacteria, colonial non-phototrophic bacteria, benthic gametophytes of green algae, and benthic sponge-like animals. Organically preserved *Beltanelliformis* impressions in the White Sea region show a very different biomarker signal when compared to organic films collected from the same surface surrounding the fossils. The surrounding organic film yields a dominant signal of steranes over hopanes (H/S = 0.061), and the steranes exhibit a strong C_{29} predominance (87%), implying a prevalent algal source. In contrast, in solvent extracts of organically preserved *Beltanelliformis*, hopane abundances are 60 times higher (H/S = 3.6) than in the algal film, implying a bacterial origin of *Beltanelliformis*. Moreover, an unusual predominance of long-chain odd-carbon numbered *n*-alkanes in the fossil demonstrates that Beltanelliformis represent colonial structures of cyanobacteria reminiscent of modern *Nostoc* colonies.